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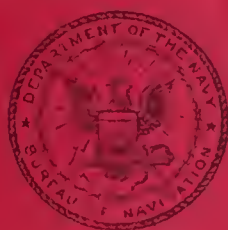
Circular

for the information of

Persons Desiring to Enter the

Navy as Acting Ensigns

for Engineering Duty



WASHINGTON
COMMERCIAL PRINTING OFFICE

1916

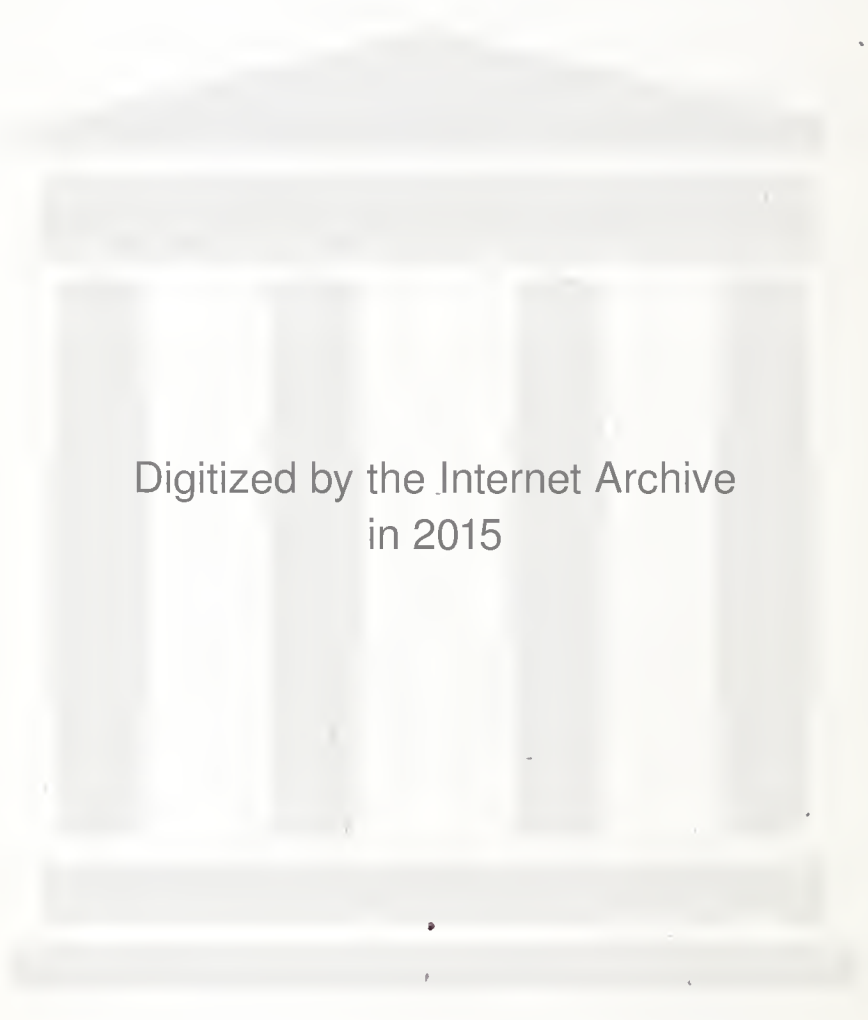
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CIRCULAR FOR THE INFORMATION OF PERSONS DESIRING TO ENTER THE NAVY AS ACTING ENSIGNS FOR ENGINEERING DUTY.

An act of Congress approved August 29, 1916, authorizes the appointment of 30 acting ensigns, annually, as follows:

"That the Secretary of the Navy is hereby authorized to appoint annually in the line of the Navy for a period of ten years following the passage of this act, in the order of merit determined by such competitive examination as he may prescribe, thirty acting ensigns for the performance of engineering duties only. Persons so appointed must have received a degree of mechanical or electrical engineer from a college or university of high standing or be graduates of technical schools approved by the Secretary of the Navy, must have been found physically qualified by a board of medical officers of the Navy for the performance of the duties required, and must at the time of appointment be not less than twenty nor more than twenty-six years of age. Such appointments shall be for a probationary period of three years, and may be revoked at any time by the Secretary of the Navy.

"Such acting ensigns shall, upon the completion of the probationary period of three years, of which two years shall have been spent on board cruising vessels and one year pursuing a course of instruction at the Naval Academy prescribed by the Secretary of the Navy, be commissioned in the grade of lieutenant of the junior grade after satisfactorily passing such examination as may be prescribed by the Secretary of the Navy, and having been recommended for promotion by the examining board and found physically qualified by a board of medical officers of the Navy.

"Such officers shall thereafter be required to perform engineering duties only, and shall be eligible for advancement to the higher grades in the manner herein provided for line officers assigned to engineering duty only."

APPOINTMENT.

A candidate for appointment as acting ensign for engineering duty must, *at the time of appointment*, be a citizen of the United States, not less than 20 nor more than 26 years of age, a candidate who has passed his twenty-sixth birthday not being eligible. Attention is particularly invited to the italicized portion of the preceding sentence. Although a candidate may successfully pass the professional and physical examination his appointment can not be made unless he is within the prescribed age limit at the time he accepts an appointment that may be tendered by the department after passing all examinations. The age limit is prescribed by law and the Navy Department has no discretion in the matter of waiving same.

Therefore, no person will be permitted to appear who will pass his twenty-sixth birthday within two months after the date set for the examination. This is done in order to prevent candidates from going to the trouble and expense of appearing for examination when it is certain that they can not be examined, have their papers marked by the local board in Washington, and their appointments issued and accepted before reaching the statutory age limit of 26.

Applications for appointment should be made to the Chief of Bureau of Navigation, Navy Department, Washington, D. C., and one requirement is that the application be in the *handwriting* of the candidate, and in the following form:

Sir:

I request permission to be examined at, for appointment as acting ensign for engineering duty. I was born at on day of; and am a citizen of the United States, residing in County of, in the State of

My occupation is that of, am a graduate of; character of degree received

The following is a description of my scientific work performed before or after graduation,

I am inclosing certificates as to moral character, habits, and citizenship; also a certificate from the faculty of the above-mentioned school (or college) which shows the full course pursued, my relative standing, the degree conferred on me, and my deportment as a student.

Very respectfully,

The CHIEF OF BUREAU OF NAVIGATION,
Navy Department, Washington, D. C.

Applications must be accompanied by testimonials as to citizenship, good moral character, and correct habits, from at least two persons of prominence who have personally known the applicant long enough to form a correct opinion of him.

Upon the receipt of an application for appointment as acting ensign same will be promptly acknowledged, and if the candidate is considered eligible a permit will be issued in time to enable him to appear for the professional examination.

PROFESSIONAL EXAMINATION.

The professional examination of candidates will be held simultaneously throughout the United States, after which all papers will be forwarded to the local board at Washington, D. C., for marking. When this has been done permits will be issued to the successful candidates authorizing them to appear for the physical examination. Candidates should promptly advise the Bureau of Navigation of any change of address in order that permits, if issued, may reach them promptly.

The following *sample* schedule of subjects and *sample* set of questions are given in order that candidates may have an idea of the scope of the professional examination:

Day.	Time.	Subjects.	From—	Average.
	<i>Hours.</i>			
First.....	3	Marine engineering.—Propelling machinery. (Sheet A.)	9 a. m. to 12 m.....	
	3	Marine engineering—Boilers. (Sheet B).....	2 p. m. to 5 p. m.....	
Second....	3	Marine engineering—Auxiliary machinery and operations. (Sheet C.)	9 a. m. to 12 m.....	
	3	Marine engineering—Internal combustion and explosive engines. (Sheet D.)	2 p. m. to 5 p. m.....	
Third....	3	Electricity. (Sheet E).....	9 a. m. to 12 m.....	
	1 ³ ₄	Applied mechanics. (Sheet F).....	1.15 p. m. to 3 p. m.....	
	1 ³ ₄	Heat and thermo-dynamics. (Sheet G).....	3.15 p. m. to 5 p. m.....	
Fourth....	1 ³ ₄	Hydraulics and pneumatics. (Sheet H).....	8.30 a. m. to 10.15 a. m.....	
	1 ³ ₄	Physics and chemistry. (Sheet I).....	10.30 a. m. to 12.15 p. m.....	
	2 ³ ₄	Shop methods, and hand and machine tools. (Sheet J.)	2 p. m. to 4.30 p. m.....	

MARINE ENGINEERING—PROPELLING MACHINERY.

(Sheet A.)

- M. E. 1. Describe a modern triple expansion marine engine and the auxiliary machinery necessary for its operation.
- M. E. 2. Sketch and describe the Stephenson link valve gear as used on marine engines.
In a multiple expansion marine engine, how is this valve gear fitted so as to permit the independent varying of the cut-off in each cylinder when going ahead, the steam to follow full stroke when backing?
- M. E. 3. Describe the method of measuring the pitch of a screw propeller.
Illustrate with sketches.
Explain the meaning of the following terms:
(a) Helicoidal area. (b) Projected area. (c) Disk area. (d) Pitch.
(e) Slip.
- M. E. 4. Describe the Parsons marine steam turbine. Show by diagram the action of the steam on the blades and sketch and describe the following details: dummy cylinders, casing and packing rings; facial, and fin or radial packing rings, stating where and why each type of packing ring is used, and clearance in each case.
- M. E. 5. Explain the principles of the steam engine indicator. Applied to the cylinder of a marine engine, what points are revealed directly by the diagram? What particulars may be calculated or inferred? How many indicators are used for each cylinder, and how are they connected?

MARINE ENGINEERING—BOILERS.

(Sheet B.)

- B. 1. Name, sketch, and describe a water-tube marine boiler used on a seagoing vessel, showing clearly its main features. Show by arrows the circulation of the water and of the gases of combustion. Give two views of the boiler. State the material used in the following parts: Steam drums, headers or down comers, and tubes.
- B. 2. Give descriptions and explanations of what is meant by the terms "Closed fire-room system of forced draft" and "Closed ashpit system of forced draft," with the comparative advantages and disadvantages of the two systems. How is the intensity of the draft measured?
- B. 3. Give a full description of an oil-burning system, including the fuel storage and settling tanks, piping, and burners.
- B. 4. Describe a gas-analysis apparatus and its use as applied to smokestacks. What are the benefits gained from its successful operation?
- B. 5. What is the object of a time-firing device in the engine and fire rooms of a seagoing vessel? Give a detailed description of one type and its method of operation.

MARINE ENGINEERING—AUXILIARY MACHINERY AND OPERATION.

(Sheet C.)

- A. M. & O. 1. Describe an evaporating and distilling plant as fitted on board a modern seagoing vessel to supply fresh water, showing by outline sketch all its component parts, connections, lead of piping, and attachments.
- A. M. & O. 2. State the principles involved in refrigerating by the compression and expansion of a gas, and describe in detail, including all fittings, the refrigerating apparatus as used on board a seagoing vessel. Only outline sketches required.

- A. M. & O. 3. Describe a hydraulic ash ejector, discharging above the water line, and explain its operation. How is excessive erosion at the curves in the discharge pipe prevented? What type of pump is necessary for its operation? State reasons.
- A. M. & O. 4. How do you measure the clearance between a journal and its brasses? What clearance would you permit for crank-pin journal of a large marine engine?
- A. M. & O. 5. Describe in detail and in proper sequence the routine of operation and management, in a fireroom and in an engine room, in raising steam and starting a reciprocating engine.
- A. M. & O. 6. Describe the process of warming up a turbine preparatory to starting it. State type of turbine.
- A. M. & O. 7. With coal as fuel, what percentage of CO_2 in the smoke-pipe gases represents maximum efficiency? How is the percentage of CO_2 determined? What effect has a leaky boiler casing on the percentage of CO_2 ?

INTERNAL COMBUSTION AND EXPLOSIVE ENGINES.

(Sheet D.)

- I. C. E. 1. Describe the basic principle employed in the operation of a gasoline or explosive engine and the Diesel or internal combustion engine, stating clearly the difference between the two. No sketches required.
- I. C. E. 2. Describe the 2-cycle and 4-cycle types of gasoline engines and their operation, illustrating your answer with sketches as necessary.
- I. C. E. 3. Describe the 2-cycle and 4-cycle types of Diesel oil engine and their operation. Illustrate your answer with sketches as necessary. How does the economy of this engine compare with that of the steam engine?
- I. C. E. 4. Sketch a carbureter and describe its operation as used with a gasoline engine; the sketch to show a cross section.
- I. C. E. 5. Discuss the use of Diesel engines of the 2 and 4 cycle types for the propulsion of seagoing vessels in competition with the steam engine. State which type you consider the best, giving reasons for your selection.

ELECTRICITY.

(Sheet E.)

- E. 1. Name and define the international or legal electrical units.
- E. 2. Define alternating current, frequency, cycle, and electric oscillation. For what purpose is alternating current used on board naval vessels, and how is it generated?
- E. 3. Describe a motor generator and a dynamotor and their operation.
- E. 4. No. 1 dynamo is in operation and delivering current to the bus bar. On account of increased load, it is necessary to start No. 2 dynamo and connect it in parallel with No. 1. Explain what is meant by connecting the two dynamos in parallel, and how it is accomplished. Make line sketch showing leads, switches, etc.
- E. 5. State the fundamental principle of wireless telegraphy. Describe a radio plant and its operation. Make outline sketch showing all parts.

APPLIED MECHANICS.

(Sheet F.)

1. (a) Specify some of the different stresses propeller shafts are subject to in sea-going vessels.
(b) What is the equivalent of 1 horsepower in foot-pounds per second?
2. (a) What is the difference between "moment of a force" and "momentum of a body"?
(b) What is meant by "dead load" friction and friction of the "working load" in a marine engine?
3. To what pressure are Scotch boilers tested and what methods are commonly used?
4. Specify what kind of material is used for the following parts of engines or turbines:
(a) Steam cylinders. (b) Piston rods. (c) Bed plates. (d) Headers in Babcock & Wilcox boiler. (e) Turbine rotors. (f) Turbine casings. (g) Condensers and condenser tubes.
5. Explain the assumptions made in connection with the subject of boiler bracing, and show how the principles of mechanics are applied in these problems.

HEAT AND THERMODYNAMICS.

(Sheet G.)

1. (a) What is meant by a British thermal heat unit (B. t. u.), and how many, approximately, are there in a pound of coal and oil, respectively?
(b) What means are used for measuring furnace and uptake temperatures in boiler installations?
2. (a) What is moisture in steam? Describe how it is measured.
(b) What is superheated steam and how is it obtained? What is the limit of superheat used in marine engines, and why?
3. (a) What is thermodynamic efficiency?
(b) Give an idea about the method used for an approximate determination of the thermodynamics efficiency of an engine or turbine.
4. (a) State what is meant by total heat in saturated steam and what parts it consists of.
(b) Enumerate and explain the principal heat losses in a steam plant; in the boilers; in the engine.
5. (a) What is the effect of the variation of the load on the efficiency and steam consumption of a steam engine and what are the principal causes?
What is:
(b) Efficiency of the boiler?
(c) Efficiency of the boiler and grate?

HYDRAULICS AND PNEUMATICS.

(Sheet H.)

1. (a) Explain what is meant by a contracted weir, a suppressed weir, and triangular weir. Which is the most accurate for measuring, a triangular or a rectangular weir?
(b) In the flow of water from a tank through a sharp-edged orifice what coefficients have to be considered in finding the quantity of water flowing through this orifice?
2. (a) A pump is used to force feed water into a boiler. Explain the different heads that have to be taken into account in pumping the water.
(b) How would you find the horsepower necessary to pump water to a certain height?
3. (a) Explain and describe a Piezometer tube, a pitot tube, and a Venturi meter.
(b) How would you find the total pressure on the bottom of a tank completely full of water?

4. How is slip of a pump figured? Duty trials of a pump? What are the efficiencies of centrifugal and reeiprocating pumps?
5. (a) What type of air compressor would be necessary to compress air from atmospheric pressure to 1,000 pounds per square inch?
(b) Why is a multiple stage compressor more economical than a single stage for high degrees of compression?

PHYSICS AND CHEMISTRY.

(Sheet I.)

1. (a) What instruments are used for measuring vacuum, engine, and boiler pressure?
(b) What is compound gage and where is it used?
(c) What is "pressure of gage"?
(d) What is absolute pressure?
2. (a) Describe the process of the formation of boiler-tube incrustation.
(b) What is the remedy?
3. (a) Explain the causes of corrosion in boilers, condensers, sea connections, propellers, and shafting.
(b) What partial remedy exists?
4. (a) Explain combustion of fuel.
(b) Which are the principal fuels?
5. (a) What average percentage of phosphorus and sulphur may be allowed in first-class machinery forgings?
(b) What physical effect upon the general properties of the material may be ascribed to the presence of such ingredients?
(c) What is Dalton's law as to gas mixtures?

KNOWLEDGE OF SHOP MACHINERY, GENERAL SHOP PRACTICE, AND REPAIR WORK.

(Sheet J.)

1. Describe the molding, casting, and machining of a cylinder for a marine engine. The description to include all tools used and shops in which the work is done. The cylinder to be machined ready for installation.

List of points authorized for professional examinations.

Alabama.....	Birmingham. Demopolis. Dothan. Florence. Huntsville. Mobile. C. H. Montgomery. Opelika.	Colorado.....	Colorado Springs. Denver. Durango. Fort Collins. Fort Morgan. Grand Junction. La Junta. Leadville. Monte Vista. Montrose. Pueblo. Trinidad.	Georgia.....	Albany. Athens. Atlanta. Augusta. Columbus. Macon. Rome. Savannah. Thomasville. Waycross.
Arizona.....	Clifton. Douglas. Flagstaff. Globe. Phoenix. Prescott. Tucson. Yuma.	Connecticut....	Hartford. Middletown. New Haven. New London. Waterbury. Willimantic.	Hawaii.....	Honolulu. C. H.
Arkansas.....	Camden. Fayetteville. Fort Smith. Helena. Jonesboro. Little Rock. Texarkana.	Delaware.....	Dover. Wilmington.	Idaho.....	Boise. Coeur d'Alene. Grangeville. Moscow. Pocatello. Sandpoint. St. Anthony. Twin Falls. Weiser.
California.....	Chico. Eureka. Fresno. Los Angeles. Red Bluff. Riverside. Sacramento. San Diego. San Francisco. San Jose. San Luis Obispo.	District of Columbia.....	Washington.	Illinois.....	Cairo. Urbana. Chicago. East St. Louis. Effingham. Freeport. Galesburg. Peoria. Quincy. Rock Island. Springfield.

List of points authorized for professional examinations—Continued.

Indiana.....	Angola. Bloomington. Evansville. Fort Wayne. Indianapolis. Jeffersonville. La Fayette. Marion. Richmond. South Bend. Terre Haute. Valparaiso.	Michigan.....	Ann Arbor. Cheboygan. Detroit. Escanaba. Grand Rapids. Ironwood. Kalamazoo. Lansing. Manistee. Marquette. Saginaw. Sault Ste. Marie. Traverse City.	New Hamp- shire.	Berlin. Concord. Hanover. Keene. Manchester. Plymouth. Portsmouth.
Iowa.....	Ames. Burlington. Cedar Rapids. Council Bluffs. Creston. Davenport. Denison. Des Moines. Dubuque. Fort Dodge. Iowa City. Mason City. Ottumwa. Sioux City. Spencer. Waterloo.	Minnesota.....	Austin. Bemidji. Brainerd. Crookston. Duluth. Fergus Falls. International Falls. Mankato. Minneapolis. Pipestone. St. Cloud. St. Paul. Virginia. Willmar. Winona.	New Jersey....	Atlantic City. Camden. Newark. Trenton.
Kansas.....	Concordia. Dodge City. Emporia. Fort Scott. Kansas City. Lawrence. Leavenworth. Manhattan. Norton. Pittsburg. Salina. Topeka. Wichita.	Mississippi....	Corinth. Greenville. Grenada. Hattiesburg. Holly Springs. Jackson. Meridian. Natchez. Vicksburg. West Point.	New York.....	Albuquerque. East Las Vegas. Las Cruces. Raton. Roswell. Santa Fe. Tucumcari.
Kentucky.....	Ashland. Bowling Green. Covington. Hopkinsville. Lexington. Louisville. Middlesboro. Owensboro. Paducah. Somerset.	Missouri.....	Cape Girardeau. Columbia. Jefferson City. Kansas City. Kirksville. Moberly. Poplar Bluff. St. Joseph. St. Louis OLD CH. Springfield. Warrensburg.	North Carolina	Binghamton. Buffalo. Elmira. Ithaca. Jamestown. New York. C.H. Ogdensburg. C.H. Plattsburg. Poughkeepsie. Rochester. Syracuse. Troy. Utica.
Louisiana.....	Alexandria. Baton Rouge. Lake Charles. Monroe. New Iberia. New Orleans. C.H. Shreveport.	Montana.....	Billings. Bozeman. Butte. Glasgow. Great Falls. Havre. Helena. Kalispell. Miles City. Missoula.	North Dakota.	Asheville. Charlotte. Durham. Greensboro. Hickory. Raleigh. Salisbury. Washington. Wilmington.
Maine.....	Bangor. Bath. Calais. Caribou. Houlton. Lewiston. Portland. Rockland.	Nebraska.....	Alliance. Beatrice. Broken Bow. Chadron. Columbus. Grand Island. Holdrege. Lincoln. McCook. Nebraska City. Norfolk. North Platte. Omaha. O'Neill.	Ohio.....	Bismarck. Devils Lake. Dickinson. Fargo. Grand Forks. Minot. Valley City. Williston.
Maryland.....	Baltimore. Cumberland. Easton. Salisbury.	Nevada.....	Carson City. Elko. Ely. Goldfield. Reno. Fallon.	Oklahoma.....	Akron. Athens. Chillicothe. Cincinnati. Cleveland. Columbus. Dayton. Ironton. Lima. Mansfield. Marietta. Portsmouth. Sandusky. Steubenville. Toledo. Youngstown. Zanesville.
Massachusetts	Boston. Brockton. Fall River. Fitchburg. Hyannis. Lawrence. Lowell. Pittsfield. Salem. Springfield. Worcester.				Altus. Ardmore. Enid. Guthrie. Lawton. McAlester. Muskogee. Oklahoma. Vinita. Woodward.

List of points authorized for professional examinations—Continued.

Oregon.....	Astoria. Baker. Bend. Corvallis. Eugene. Grants Pass. Klamath Falls. Marshfield. Pendleton. Portland. The Dalles.	Tennessee.....	Bristol. Chattanooga. Jackson. Knoxville. Memphis. Nashville.	Washington ...	Aberdeen. Bellingham. Centralia. North Yakima. Pasco. Port Townsend. Pullman. Raymond. Seattle. Spokane. Tacoma. Vancouver. Walla Walla. Wenatchee.
Pennsylvania..	Altoona. Dubois. Erie. Galeton. Harrisburg. Philadelphia. Pittsburgh. South Bethlehem State College. Uniontown. Warren. Wilkes-Barre. Williamsport.	Texas.....	Abilene. Amarillo. Austin. Brownsville.C.H. Bryan. Dallas. El Paso. C. H. Houston. Lubbock. Nacogdoches. San Angelo. San Antonio. Texarkana. Waco. Wichita Falls.	West Virginia...	Bluefield. Charleston. Elkins. Grafton. Hinton. Huntington. Martinsburg. Morgantown. Parkersburg. Wheeling.
Porto Rico.....	San Juan.	Utah.....	Logan. Ogden. Provo. Salt Lake City.		
Rhode Island..	Providence.				
South Carolina.	Charleston. Chester. Columbia. Florence. Greenville. Greenwood. Orangeburg. Sumter.	Vermont.....	Brattleboro. Burlington. Montpelier. Newport. C.H. Rutland. St. Albans. C. H. St. Johnsbury.	Wisconsin.....	Appleton. Ashland. Chippewa Falls. La Crosse. Madison. Marquette. Milwaukee. Superior. Wausau.
South Dakota.	Aberdeen. Brookings. Deadwood. Huron. Lemmon. Mitchell. Pierre. Rapid City. Sioux Falls. Watertown.	Virginia.....	Abingdon. Alexandria. Charlottesville. Clifton Forge. Lynchburg. Norfolk. Richmond. Roanoke. Staunton. Winchester.	Wyoming.....	Casper. Cheyenne. Cody. Evanston. Lander. Laramie. Rawlins. Rock Springs. Sheridan.

PHYSICAL EXAMINATION.

The physical examination will be held after the professional, and the candidate, *provided he successfully passes the professional examination*, will be authorized to appear for physical examination by a board of naval medical officers at one of the following naval stations: Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; Philadelphia, Pa.; Washington, D. C.; Annapolis, Md.; Norfolk, Va.; Charleston, S. C.; Pensacola, Fla.; New Orleans, La.; Great Lakes, Ill.; Las Animas, Colo.; Mare Island, Cal.; San Francisco, Cal.; and Puget Sound (Bremerton), Wash. As the necessary naval medical officers are available only at the above-mentioned places, physical examinations will not be conducted elsewhere.

The physical examination is thorough, and the candidate will be required to certify under oath that he is, to the best of his knowledge and belief, free from all mental, physical, and constitutional defects. If the candidate is found to be physically disqualified, the examination is concluded forthwith and he will not be appointed. It is suggested that all candidates should first cause themselves to be thoroughly examined by a competent physician, particularly regarding eyesight, hearing, and heart trouble, thus avoiding the trouble and expense of appearing for examination when not physically qualified.

No allowances will be made for the expenses of persons appearing for either of the above examinations.

PAY.

The pay of an ensign at sea is \$1,870 a year; on shore it is \$1,700 plus allowances for quarters, heat, and light.